Comparison of Clinical and Polysomnographic Characteristics of Non-Obese and Obese Patients with Obstructive Sleep Apnea

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Objective : *To compare the clinical features, anthropometric indices, and polysomnographic data between different body mass index (BMI) subgroups of obstructive sleep apnea (OSA) patients.*
Material and Method : *The authors reviewed the data from OSA patients in Siriraj Sleep Clinic from April 2005 to September 2006. Objective measurement for sleepiness (Epworth Sleepiness Scale, ESS), anthropometric measurements [body mass index (BMI), neck circumference, thyromental distance, Mallampati's score, and occlusion pattern] and polysomnographic recordings [apnea/hypopnea index (AHI) during REM and NREM periods, respiratory arousal index, periodic leg movement index, minimal oxygen saturation, total sleep time with oxygen saturation < 90%, and desaturation index] were collected. The patients were stratified into the non-obese group and obese group if their BMI was < 27 or ≥ 27 kg/m^2 respectively.*
Results : *Of the total 158 patients, 71 were non-obese and 87 were obese, no difference in mean age and sex was observed, but more patients with hypertension and coronary artery disease were noted in the obese group. Mean ESS was not different between the 2 groups. In anthropometric measurements, the obese group had statistically significant large neck circumference (41.6 ± 3.5 cm vs 37.0 ± 2.9 cm, p < 0.001), but the non-obese group had a shorter thyromental distance (56.4 ± 11.7 mm vs 61.4 ± 11.2 mm, p = 0.006), with no significant difference in Mallampati's score and occlusion pattern. In polysomnographic data, the obese group had statistical significantly more severity of various indices except for AHI during the REM period and the periodic limb movement index.*
Conclusion : *Non-obese obstructive sleep apnea patients have more bony structural change than the obese ones as demonstrated by shorter thyromental distance. But degree of abnormalities during sleep was less severe in nearly all aspects.*

Keywords : *Obstructive sleep apnea; Thyromental distance; Non-obese patients*

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Obstructive sleep apnea (OSA) is not a new disease and is currently recognized as a threat that leads to cardiovascular events. It is characterized by repetitive episodes of upper airway collapse during sleep and is one of the leading causes of excessive daytime sleepiness. Epidemiologic studies in Caucasian populations suggested that symptomatic OSA occurs at a prevalence of 1-10%[1-3]. The diagnosis of OSA is made on a combination of clinical features and diagnostic polysomnography. The prevalence and severity of OSA also have been found to be associated with race. Epidemiologic investigations by Ip et al, revealed that the prevalence of OSA in Chinese men and women are 4.1 and 2.1% respectively[4,5]. To the

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authors' knowledge, there is no exact number for OSA prevalence in Thailand.

The association between obesity and OSA is compelling. Approximately 70% of individuals with OSA are obese, and the prevalence of OSA in obese men and women is approximately 40%[6-9]. Sakakibara et al, compared non-obese (body mass index, BMI < 27 kg/m^2) and obese (BMI ≥ 27 kg/m^2) patients with OSA and revealed that higher apnea-hypopnea index (AHI) and lower minimal oxygen saturation were more common in obese than in non-obese patients. But the non-obese group had a shorter anterior cranial base and a narrower bony nasopharynx and oropharynx than the obese group[10].

The objective of the present study was to compare the clinical features, anthropometric indices, and polysomnographic data between non-obese and obese patients with OSA in Thailand.

Material and Method

This cross-sectional study was done by reviewing data from OSA patients who had complete records in Siriraj Sleep Clinic from September 2005 to September 2006. Age, sex, co-morbidity, objective measurement for sleepiness (Epworth Sleepiness Scale, ESS) and anthropometric measurements (BMI, neck circumference, thyromental distance, Mallampati's score, occlusion pattern) were recorded. Neck circumference was measured with a tape measure at the level of cricothyroid membrane. Thyromental distance was measured horizontally from the thyroid prominence to a perpendicular dropped from the soft tissue mentum. Mallampati's score was measured with mouth wide open, tongue maximally protruded without phonation, and classified into Grades I-IV. Overnight polysomnography was performed in the standardized manner in Siriraj Sleep Center. Polysomnographic data, including AHI during rapid eye movement (REM) and non-REM periods, respiratory arousal index (RAI), periodic leg movement index (PLMI), minimal oxygen saturation, total sleep time with oxygen saturation < 90%, and desaturation index, were also collected. OSA was diagnosed if there was excessive daytime sleepiness or poor performance combined with AHI > 5 events/h. The patients were stratified into a non-obese group and an obese group if their BMI was < 27 and ≥ 27 kg/m^2 respectively to match the present study by Sakakibara[10].

Numerical and categorical data were compared between groups using student t-test and Chi-square test as appropriate. For the ordinal characteristic of Mallampati score and occlusive pattern, p-values were calculated using linear-by-linear association. All statistical analyses were performed using statistical software SPSS version 10.0 (SPSS Inc, Chicago, USA). A p-value of < 0.05 was considered significant.

Results

A total of 158 patients were enrolled, 71 were in the non-obese group and 87 patients were in the obese group; no statistically significant difference in mean age, sex, and ESS was found between the two groups.

Table 1. Demographic data

	Mean ± SD or Number (%)		
	Non-obese (n = 71)	Obese (n = 87)	p-value
No. of patient	71	87	
Mean age (y)	48.0 ± 10.0	46.5 ± 11.0	0.37
Sex			
Male	54	70	0.64
Female	17	17	
Diabetes mellitus	5 (7.0)	16 (18.4)	0.064
Hypertension	16 (22.5)	46 (52.9)	<0.001*
Dyslipidemia	19 (26.8)	36 (41.4)	0.08
Coronary artery disease	1 (1.4)	8 (9.2)	0.042*
Cerebrovascular disease	1 (1.4)	1 (1.1)	1.00
Asthma	1 (1.4)	5 (5.7)	0.22
Allergic rhinitis	19 (26.8)	21 (24.1)	0.85
Epworth Sleepiness Scale	10.1 ± 5.7	11.4 ± 6.2	0.20

Table 2. Anthropometric indices

	Mean ± SD or Number (%)		
	Non-obese (n = 71)	Obese (n = 87)	p-value
Neck circumference(cm)	37.0 ± 2.9	41.6 ± 3.5	<0.001*
Thyromental distance(mm)	56.4 ± 11.7	61.4 ± 11.2	0.006*
Mallampati score			
Class I	6 (8.5)	6 (6.9)	0.17
Class II	22 (31.0)	24 (27.6)	
Class III	29 (40.8)	28 (32.2)	
Class IV	14 (19.7)	29 (33.3)	
Occlusive pattern			
0	46 (64.8)	47 (54.0)	0.052
1	10 (14.1)	10 (11.5)	
2	13 (18.3)	21 (24.1)	
3	2 (2.8)	9 (10.4)	

Table 3. Polysomnographic data

	Non-obese	Obese	p-value
AHI (events/h)			
Total AHI	32.7 ± 20.5	48.7 ± 28.1	<0.001
During REM	27.3 ± 22.2	32.7 ± 31.4	0.21*
During non-REM	31.96 ± 20.58	47.8 ± 28.9	<0.001*
Respiratory arousal index (events/h)	19.5 ± 14.9	27.1 ± 22.4	0.01*
Periodic limb movement index (events/h)	9.9 ± 11.9	13.8 ± 19.2	0.12
Minimal oxygen saturation (%)	82.2 ±12.6	69.5 ± 16.9	<0.001*
Total sleep time with oxygen saturation < 90% (%)	4.7 ± 7.2	26.3 ± 27.4	<0.001*
Desaturation index (events/h)	24.6 ± 23.5	51.6 ± 34..2	<0.001*

More patients with hypertension and coronary artery disease were commonly found in the obese group. The data are summarized in Table 1.

For anthropometric measurement, the obese group had statistically significant larger neck circumference than the non-obese group (41.6 ± 3.5 cm vs 37.0 ± 2.9 cm, $p < 0.001$). The non-obese group however, had shorter thyromental distance (56.4 ± 11.7 mm vs 61.4 ± 11.2 mm, $p = 0.006$). No significant difference in Mallampati's score and occlusive pattern were observed between the two groups (Table 2).

In polysomnographic data, the obese group had a statistical significance with regard to the higher total AHI (48.6 ± 28.1 vs 32.7 ± 20.5, $p < 0.001$), AHI during the non-REM period (47.8 ± 28.9 vs 32.0 ± 20.6, $p < 0.001$), RAI (27.1 ± 22.4 vs 19.5 ± 14.9, $p = 0.01$), minimal oxygen saturation (69.5 ± 16.9 vs 82.2 ± 12.6, $p < 0.001$), total sleep time with oxygen saturation < 90% (26.3 ± 27.4 vs 4.7 ± 7.2, $p < 0.001$), and desaturation index (51.6 ± 34.2 vs 24.6 ± 23.5, $p < 0.001$). No significant difference in AHI during REM period and PLMI between the two groups was observed (Table 3).

Discussion

The present study has shown more significant severity of OSA indices in obese patients than the non-obese ones in terms of AHI, RAI, minimal oxygen saturation, total sleep time with oxygen saturation < 90%, and desaturation index. This was in concordance with previous studies that found a higher degree of severity in obese OSA patients[10-13]. Accumulation of fat on the tongue and the soft tissue surrounding the

pharynx may increase in conjunction with higher BMI. With increasing obesity, there seems to be a shift of obstruction down to a lower level of pharyngeal airway and increase of collapsibility during sleep[14].

In the study of Sakakibara et al, comparison of cephalometric measurements revealed that obese patients with OSA had enlarged upper airway soft tissue, whereas non-obese patients had bony structure discrepancies revealed by the decrement of the anterior cranial base and mandibular length[10]. The observation of shorter thyromental distance in the present non-obese patients with OSA may correspond to the shorter anterior cranial base as previously described[15]. Interestingly, the findings of more severe OSA in Far-East Asian and Turkish men with abnormal craniofacial anatomy[16-18], may reflect the racial differences and a potential genetic basis[19].

Pongcharusathit et al, studied the clinical predictors of OSA in Thai males and found that neck circumference and Muller's maneuver grading were the important indicators[20]. The same group has also shown that cephalometry in Thai snorers with and without OSA had significant differences in sagittal dimension of the mandible, distance from the mandibular plane to hyoid, and the distance from the tip of uvula to the posterior pharyngeal wall[21]. A study in Hong Kong and Canada has also indicated that the Mallampati's score, thyromental angle, and neck circumference were the best predictors of OSA[13]. From the authors' earlier data, BMI, neck circumference, waist circumference, hip circumference, and waist/hip circumference ratio were strong predictors for OSA[22]. In the present study, the authors chose simple clinical measurements of upper airway morphology such as the Mallampati's score and thyromental distance because they are easy to perform in clinical practice. The Mallampati's score has been used by anaesthetists to help predict the degree of difficulty of endotracheal intubation[23]. It reflects the amount of soft tissue in the posterior oropharynx relative to its skeletal constraints. The thyromental distance represents the position of the chin relative to the thyroid cartilage and may be related to the length of the anterior cranial base. The Mallampati's score and thyromental distance have been shown to correlate with both difficult endotracheal intubation and OSA[24-26].

Craniofacial features in Thai patients with OSA should be explored by further detailed study and may be beneficial for surgical treatment planning in those who cannot use or cannot tolerate the standard treatment with continuous positive airway pressure.

Conclusion

Non-obese obstructive sleep apnea patients had more bony structural change than the obese ones as demonstrated by shorter thyromental distance, but the degree of abnormalities during sleep were less severe in nearly all aspects.

Acknowledgement

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การเปรียบเทียบลักษณะทางคลินิกและผลตรวจการนอนหลับระหว่างกลุ่มผู้ป่วยภาวะหยุดหายใจระหว่างการนอนหลับจากการอุดกั้นผู้ป่วยที่อ้วนและไม่อ้วน

นิธิพัฒน์ เจียรกุล, ชาญชัย ชัยภัทรพล, พิมล รัตนาอัมพวัลย์, อรรถ นานา, ชนะ นฤมาน, สุวัฒน์ ตั้งจิตยงสิวะ

วัตถุประสงค์: *เพื่อประเมินความแตกต่างของลักษณะทางคลินิก ดัชนีด้านขนาดร่างกายและข้อมูลผลตรวจการนอนหลับ ระหว่างกลุ่มผู้ป่วยภาวะหยุดหายใจระหว่างการนอนหลับจากการอุดกั้นที่มีดัชนีมวลกายต่างกัน*

วัสดุและวิธีการ: *ทำการรวบรวมข้อมูลของผู้ป่วยภาวะหยุดหายใจระหว่างการนอนหลับจากการอุดกั้นที่ทำการติดตามในคลินิกเฉพาะโรคระหว่างเดือนเมษายน พ.ศ.2548 ะ เดือนกันยายน พ.ศ.2549 โดยบันทึกค่า Epworth Sleepiness Scale (ESS) ดัชนีด้านขนาดร่างกาย (ดัชนีมวลกาย, เส้นรอบวงคอ, ระยะจากคางถึงลูกกระเดือก, Mallampatis score, และ occlusion pattern) และผลตรวจการนอนหลับ (ดัชนีการหยุดหายใจ ดัชนีการตื่นจากผลการหายใจ ดัชนีการเคลื่อนไหวของขา ระดับความอิ่มตัวของออกซิเจนต่ำสุด ช่วงการนอนที่มีระดับความอิ่มตัวของออกซิเจนน้อยกว่า 90 % และ ดัชนีการลดลงของระดับความอิ่มตัวของออกซิเจน) ผู้ป่วยถูกแบ่งเป็นกลุ่มที่ไม่อ้วนและกลุ่มที่อ้วนตามค่าดัชนีมวลกายที่ <27 หรือ >27 กก./ม.^{2}*

ผลการศึกษา: *มีผู้ป่วยทั้งหมด 158 ราย อยู่ในกลุ่มที่ไม่อ้วน 71 ราย และกลุ่มที่อ้วน 87 ราย ทั้งสองกลุ่มไม่มีความแตกต่างกันในเรื่องอายุและเพศแต่พบโรคร่วมคือความดันโลหิตสูงและ หลอดเลือดหัวใจในกลุ่มที่อ้วนได้มากกว่าค่าเฉลี่ย ESS ในทั้งสองกลุ่มไม่มีความแตกต่างกัน สำหรับดัชนีด้านขนาดร่างกาย กลุ่มที่อ้วนมีเส้นรอบวงคอที่ใหญ่กว่าอย่างมีนัยสำคัญทางสถิติ (41.6 $\pm$ 3.5 ซม. vs 37.0 $\pm$ 2.9 ซม., p <0.001) แต่กลุ่มที่ไม่อ้วนมีระยะจากคางถึงลูกกระเดือกสั้นกว่าอย่างมีนัยสำคัญทางสถิติ (56.4 $\pm$ 11.7 มม. vs 61.4 $\pm$ 11.2 มม., p = 0.006) ในด้าน Mallampatis score และ occlusion pattern ไม่มีความแตกต่างกัน สำหรับผลตรวจการนอน หลับพบว่ากลุ่มที่อ้วนมีความรุนแรงของดัชนีต่างๆ อย่างมีนัยสำคัญทางสถิติ ยกเว้นค่าดัชนีการเคลื่อนไหวของขา*

สรุป: *ผู้ป่วยภาวะหยุดหายใจระหว่างการนอนหลับจากการอุดกั้นที่ไม่อ้วนมีความผิดปกติของโครงสร้างกระดูกมากกว่ารายที่อ้วน เห็นได้จากการมีระยะจากคางถึงลูกกระเดือกที่สั้นกว่า แต่มีดัชนีความผิดปกติของการนอนหลับเกือบทั้งหมดรุนแรงน้อยกว่า*